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Evolution of spin relaxation processes in LiY 1-xHo xF 4 studied via ac-susceptibility and muon spin relaxation

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Abstract

We present measurements of magnetic field and frequency dependence of the low-temperature (T = 1.8 K) ac-susceptibility and temperature and field dependence of the longitudinal field positive muon spin relaxation (μSR) for LiY 1-xHo xF 4 with x = 0.0017, 0.0085, 0.0408, and 0.0855. The fits of numerical simulations to the susceptibility data for the x = 0.0017, 0.0085, and 0.0408 show that Ho-Ho cross-relaxation processes become more important at higher concentrations, signaling the crossover from single-ion to correlated behavior. We simulate the muon spin depolarization using the parameters extracted from the susceptibility, and the simulations agree well with our data for samples with x = 0.0017 and 0.0085. The μSR data for samples with x = 0.0408 and 0.0855 at low temperatures (T < 10 K) cannot be described within a single-ion picture of magnetic field fluctuations and give evidence for additional mechanisms of depolarization due to Ho3 + correlations. We also observe an unusual peak in the magnetic field dependence of the muon relaxation rate in the temperature interval 10-20 K that we ascribe to a modification of the Ho3 + fluctuation rate due to a field induced shift of the energy gap between the ground and the first excited doublet crystal field states relative to a peak in the phonon density of states centered near 63 cm -1. © 2012 American Physical Society.

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